of laser fields play a crucial role. Two such fascinating fields can be identified immediately. One is ‘coherent control’, where the thrilling ultimate goal is to guide chemical reactions by using the tailored coherence properties of laser light^{4,5}. As well as selective bond breaking and bond rearrangements, selective bond formation also has been demonstrated recently⁶ using feedback-optimized laser pulses⁷. Complementarily, experiments under gas-phase collision-free conditions, such as the one presented by Ohmori *et al.*³, could identify individual control mechanisms especially in the promising non-perturbative regime of light–matter interaction. Direct comparisons between theory and such investigations⁸ could shed light onto the ‘black-box type’ feedback-optimized experiments, and have the potential to increase the efficiency and the selectivity when controlling photochemical systems.

The other possible application is in ‘quantum information technology’. Here, combining shaped femtosecond light fields with the excitation of internal motional states of molecules has the exciting prospect of enabling decoherence-free logic operations and algorithms at the speed of molecular dynamics⁹, although several important barriers have to be overcome before this goal can be achieved¹⁰. Considering that silicon-based technology will soon reach its fundamental limits, this experiment³ could also lead to progress in classical information processing as it opens a new route to ultrafast information encoding and manipulation using single-particle interference.

It is the development of sophisticated tools that have traditionally enabled engineers to build instruments that lead us towards new horizons. The same now holds for quantum engineering with the help of tailored light fields. □

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Published online: 10 April 2011

PLANETARY IMAGING

Messages from Mercury

In 2004, NASA launched its Messenger spacecraft. On 17 March this year, following two flybys of Venus and three of Mercury, Messenger became the first mission to enter orbit about Mercury. By the end of the month, it was returning remarkable images of the planet’s surface, including this one — the first — dominated by the spectacular Debussy crater.

Named for French composer Claude Debussy, the crater has an impressive system of ‘rays’, created by ejecta, extending over hundreds of kilometres. Also in the lower sections of the image are areas of the surface that have never been imaged before: NASA’s Mariner 10 viewed only about 45% of the planet on flybys in the mid 1970s.

Messenger — an acronym for Mercury surface, space environment, geochemistry and ranging — carries instruments to probe key issues, such as the density and geological history of the planet, and the nature of its magnetic field. Mercury and Earth are the only inner planets to have global magnetic fields, although Mercury’s is about 100 times weaker than Earth’s, at the planetary surface.

Messenger will remain in orbit for the next year. That’s the next Earth year — equivalent to more than four years on Mercury, but only two of its solar days.

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